MetNet Landers for Mars Missions

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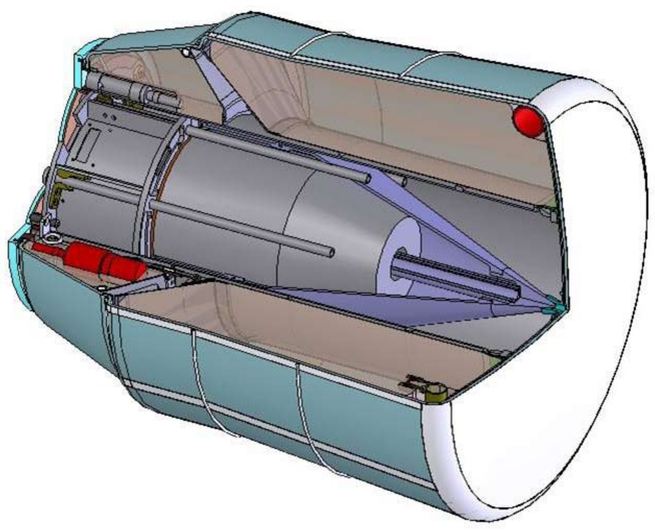
Mission Scientific Goals

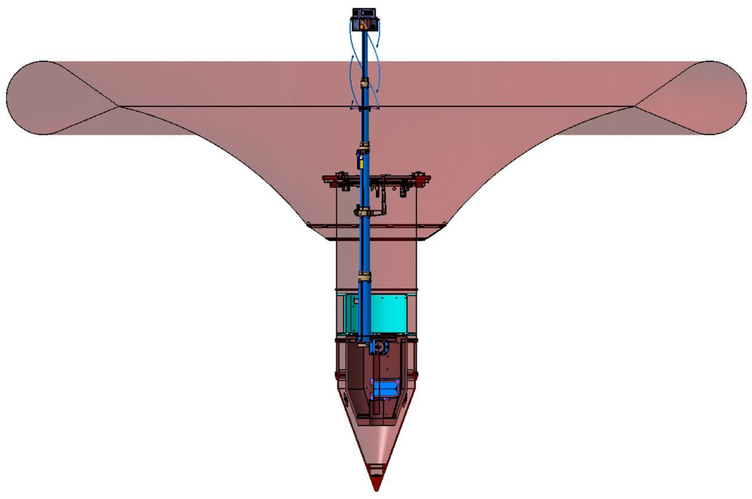
With the help of the meteorological lander network the following scientific questions will be addressed:

- Atmospheric dynamics and circulation
- Surface to Atmosphere interactions and Planetary Boundary Layer
- Dust raising mechanisms
- Cycles of CO_2, H_2O and dust
- Evolution of the Martian climate

The understanding of these topics is important for the preparation of any future manned mission to Mars where reliable weather forecasts for the envisioned landing sites will be needed.



MetNet lander in stowed cruise position. Picture © FMI.



MetNet lander after landing with boom deployed. Picture © FMI.

MetNet Mass Budget

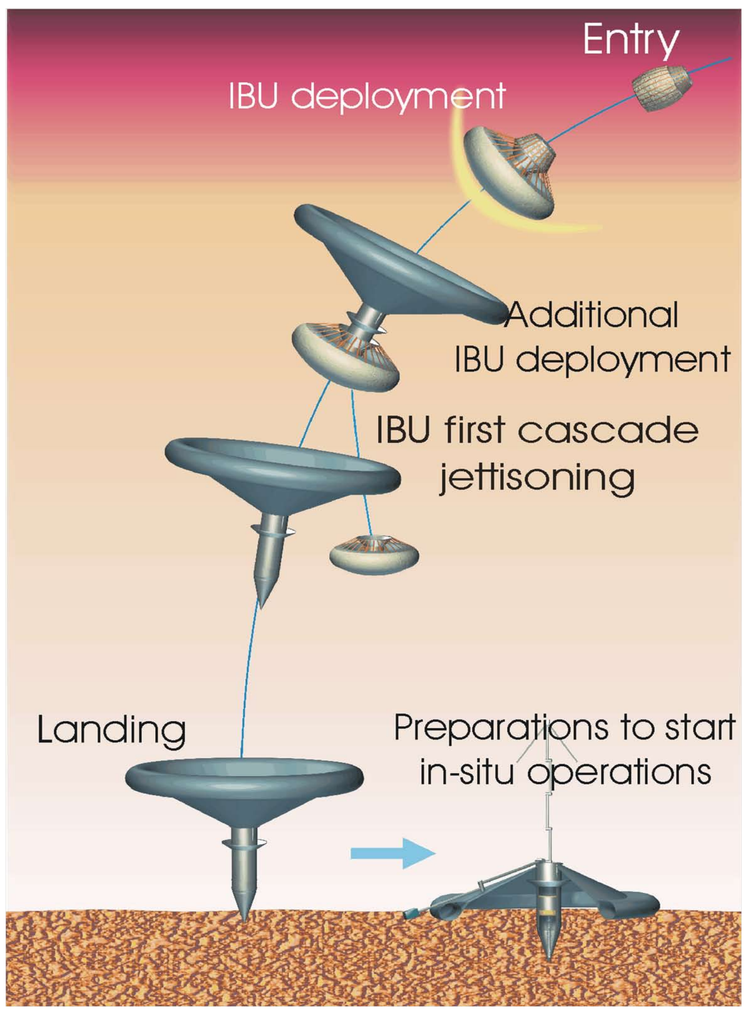
EDLS		8.5 kg
Landing Module		13.8 kg
Lander Body	9.8 kg	
P/L Module	4.0 kg	
Total Entry Mass		**22.3 kg**

The Mars MetNet Precursor Mission (MMPM) is the technology demonstration project for the deployment of a larger network of small meteorological stations onto the surface of Mars. The development is done in collaboration between the Finnish Meteorological Institute (FMI), the Russian Lavoshkin Association (LA), the Russian Space Research Institute (IKI) and the Spanish National Institute for Aerospace Technology (INTA). The purpose of MMPM is to confirm the concept of deployment for the mini-meteorological stations onto the Martian surface, to get atmospheric data during the descent phase, and to get information about the meteorology and surface structure at the landing site from the meteorological station during one Martian year or longer.

Deployment Scenario

The MetNet Lander (MNL) will be separated from the transfer vehicle either during the Mars-approaching trajectory or from the Martian orbit. The point of separation relative to the Martian orientation and the initial deployment angle define the final landing site, which additionally is influenced by atmospheric parameters during the descent phase.

For the two initial precursor missions only low latitude / low altitude landing sites are planned to maximize the success of the descent and the information gained from the MNL's behavior during its flight across the different layers of the Martian atmosphere. This information is transmitted to the transfer vehicle via dedicated beacon antennas already during the descent phase. For the precursor missions this results in an initial velocity of 6080 m/s, a relative entry angle of -15º and a landing velocity of about 50 m/s. Later units will go also to higher latitudes and altitudes, using optimized payloads and power systems.



MetNet deployment and landing scenario. Picture © FMI.

Core Payload

The core payload contains the meteorological sensors for temperature, pressure and humidity measurements, a 4-lense panoramic camera and a 3-axis accelerometer for descent control. For the precursor missions this is extended to include also a 3-axis gyroscope device. Additionally a Solar Irradiance Sensor with a wide range of dedicated wavelength filters, an optical dust sensor, a 3-axis magnetometer and a radiation monitor are included in the first units' payload.

Power Sources

The low-latitude MNLs are powered by two Lithiumion batteries in a thermally sealed container, charged by flexible solar cells on the upper side of the Additional Inflatable Breaking Unit (AIBU), which provide a daily power average of about 300mW. For high-latitude landing sites radioactive sources will be used.

Launch Opportunities

As the requirements for a transfer vehicle are not very extensive, the MNL(s) could be launched with any mission going to Mars. This could be a piggybag solution to a Martian orbiter from ESA, NASA, Russia or China or an add-on to a planned larger Martian Lander like ExoMars. Also a dedicated launch with several units from LEO is under discussion.

Payload Instruments

Atmospheric Instruments

- Pressure Device MetBaro (FMI)
- Temperature Sensors (IKI)
- System Accelerometer (FMI)
- Humidity Device MetHumi (FMI)

Optical Devices

- Panoramic Camera (LA)
- Solar Irradiance Sensor MetSIS with Optical Wireless Link System OWLS (INTA)
- Dust Sensor, DS (UCM/ARQ)

Composition and Structure Devices

- Tri-axial magnetometer MOURA (INTA)
- Radiation Monitor (NUAA)
- Triaxis System Accelerometer and Gyroscope (FMI)

More information from the Mars MetNet Mission website http://metnet.fmi.fi

Poster design: Harri Haukka, FMI